REMARKS/ARGUMENTS

Claims 18-24 and 38 are pending in this application. Claims 1-17 have been canceled. Claims 18-20 and 22 have been amended. Claims 25-37 have been withdrawn.

Claims 18-24 and 38 were rejected under Section 112 because of a lacking antecedent in claim 18. Claim 18 has been amended to provide the necessary antecedent.

In view thereof, applicants request the retraction of the Section 112 rejection.

With regard to the corresponding comment in Section 5 of the Office Action, applicants confirm that the subject matter of the pending claims was commonly conceived and commonly owned at the time the inventions covered by the pending claims were made.

Substantively, all pending claims 18-24 and 38 were rejected for obviousness "over Krikorian (US 4,541,417) and one of ordinary skill in the art". Clarification of the rejection is respectfully requested in a new, **non-final** Office Action unless this Amendment leads to the allowance of this application. A rejection over "one of ordinary skill in the art" is clearly an improper Section 103 rejection.

Further, applicants are not able to discern with reasonable clarity as to what references the Office Action relies on and what the Office Action is alleging with respect to what claim elements are believed to be taught by or otherwise rendered obvious over "one of ordinary skill in the art" and/or "Chou", which is not identified in the Office Action. Accordingly, the required proper factual basis for the rejection under *Graham* and the MPEP has not been provided.

Applicants are aware that a patent to Chou (WO 98/05379) was the sole reference over which the claims were rejected in the earlier Office Action of October 1, 2009, and they will further address that Chou reference on that basis below. However, the current Office Action provides no insight whether the same Chou reference is relied upon, and where the portions of Chou that allegedly render claim 18 in combination with Krikorian obvious can be found. As a result, applicants are unable to adequately respond to the Office Action.

In view thereof, applicants specifically request that the next Office Action be a non-final Office Action, should it continue to reject any claims over Chou, alone or in combination with Krikorian. If a non-final Office Action will not issue under such circumstances, applicants will be denied an opportunity to understand the actual rejection of the claims and to adequately respond to it.

Turning now to the rejection of the claims in the present Office Action, Krikorian was viewed as disclosing a processor which is adapted to carry out at least part of the features a) to n) of the processor of previously pending independent claim 18, which has since been amended. The Office Action concludes that combining the teaching of Chou (without identifying what Chou is) with the teaching of Krikorian as well as with the general knowledge of a person skilled in the art would enable that person to obtain the remaining features of claim 18 not taught by Krikorian and hence to obtain the subject matter of claim 18, thereby rendering claim 18 obvious.

The object of the present invention as defined by claim 18 is to provide a virtually universally applicable method and apparatus by which a substantial degree of heart unloading can be achieved by appropriate stimulation of the patient which can be applied without practical time limitation and in particular without any restrictions of the muscles to be stimulated, except for the heart muscle itself.

The object of the present invention is satisfied by an electrotherapy apparatus comprising a sensor for detecting periodically recurring signal peaks, for example the R-R peaks of an electrocardiogram of a person, a processor for deriving from the periodically recurring signal peaks of the ECG, a time delay corresponding to approximately the end of the T-wave, a trigger system or a circuit initiated by an output signal of the processor or embodied within the processor for applying electrical stimulations to one or more active electrodes provided on the person at a time related to the end of the time delay, with the processor also being adapted to compare values from the individual heart beat spectra detected by the ECG to technical limits and also to personal limits for that patient using the steps disclosed in steps a) to n) of claim 18. This heart-beat-by-heart-beat comparison is necessary, because the heart rate of patients is not

constant; i.e. it fluctuates during treatment, for example, because the patient starts to relax during the treatment, which causes the heart rate to generally slow down, and a human's heart beat is also generally subjected to minor fluctuations in heart rate even when the patient is at complete rest.

The present invention recognizes that, to achieve a reduction in heart load, the electrical stimulation has to take place starting at around the end of the T-wave, i.e. in synchronization with the heart rhythm in the counterpulsation mode, and continuing for a period finishing before the next R-peak. Having made this recognition, the inventors of the present invention provided the electrotherapy apparatus with a processor which is capable of comparing values deduced from the recurring heart signals of the patient, detected using the ECG, with technical limits and personal limits selected for that patient. Moreover, the processor is capable of subsequently adapting the stimulation pattern when the heart rate changes. In particular, the time delay between the R-wave and the end of the T-wave has to be readjusted for each pulse, using the so-called Bazett relationship.

The steps used by the processor to achieve this readjustment are defined by steps a) to n) of claim 18. These steps set forth how the processor processes the signals of successively detected signal peaks which correspond to a person's heart rate. The processor thereby obtains certain values from the detected signal peaks, such as e.g. the offset between R-peak and the T-wave, and/or the duration of individual R-R phases, etc.

In step a) the processor determines the time between successive pairs of signal peaks, such as the R-R peaks, and thus determines the person's heart rate. Following this in step b), the processor compares the value acquired for the heart rate with maximum and minimum permissible technical limits permitted by the apparatus and/or in step c) compares the value of the heart rate with maximum and minimum permissible selected limits.

In step d) the processor determines whether the value for the heart rate exceeds a preceding value or a preceding value averaged over a plurality of heart beats by more than a defined amount, and then in step e) the processor determines whether the value is less than a

preceding value or a preceding value averaged over a plurality of heart beats by more than a defined amount. In step f) the processor initiates the trigger system or circuit only when the comparisons b) and/or c) are favorable and the determinations d) and e) show that the value does not exceed or undercut the preceding value or the preceding average value by more than the defined amount.

In step g) the processor is adapted to close a measurement window for the sensor once a determination has been made that the comparisons made in steps b) and/or c) are favorable and that the values determined in steps d) and e) show that the value for the detected heart beat does not exceed the preceding value or the preceding average value by more than the defined amount and that that value is not less than the preceding value or the preceding average value by more than the defined amount. The processor closes the measurement window prior to triggering the trigger system.

In addition to this time delay, the processor calculates a maximum stimulation length in step h). In step i) the processor checks that the derived value of the time delay is greater than or equal to a delay time which is equivalent to a trigger delay plus a calculation delay, where the trigger delay is the delay between the initiation of a trigger signal delivered by the sensor which corresponds to the detection of a first signal peak and the time this signal takes to reach the processor and where the calculation delay is the time required by the processor to derive the delay.

In step j) the processor checks that the derived time delay is less than or equal to the maximum stimulation length and, if necessary, revises the derived time delay, such that it fulfills the two conditions (i.) that the derived time delay is greater than or equal to the trigger delay plus the calculation delay and (ii.) that the derived time delay is less than or equal to the maximum stimulation length.

In step k) the processor calculates a maximum duration which is equal to the maximum stimulation length minus the time delay, and in step l) the processor calculates a duration of the electrical stimulation and a maximum duration value which is equal to the

maximum stimulation length minus the derived time delay. Following this the processor checks whether the calculated duration is less than or equal to the maximum duration and if not adapts the duration such that it is less than or equal to the maximum duration.

In step m) the processor calculates an open measurement window time which is equal to the derived time delay, or the adapted delay, if the delay was adapted, plus the duration or the adapted duration, if the duration was adapted, plus a safety margin. Finally in step n) the processor sends an output signal to the trigger system during the measurement window and opens the measurement window at the calculated time permitting the recognition of the detection of a further peak of the electrocardiogram by the sensor.

Thus, the processor of the present invention not only applies electrical stimulation to one or more active electrodes, it also controls the stimulation, such that the stimulation is provided relative to the end of the T-wave for a duration which does not exceed technical and/or harmful limits to the patient's heart.

In contrast to this and in contrast to the Examiner's assertions in the Office Action, Krikorian does <u>not</u> disclose a processor. On page 3, line 9, the Office Action states that Krikorian discloses a processor (e.g. via the disclosed timer, 15, and the disclosed delay circuit, 136). In actual fact the timer 15 disclosed in Krikorian is a mere counter, as explained in Krikorian by the following (see col. 4, lines 9-53):

"Referring to FIG. 1, a coronary augmenter is shown herein connected to a human cardiac patient 10 through monitoring electrodes, in the form of conventional electrocardiogram electrodes 12. Electrodes 12 connect to a timing means shown herein as an electrocardiac sensing means 14. As explained hereinafter in further detail, sensing means 14 has circuitry similar to that found in an electrocardiogram-type of system. An alternate sensing means is shown herein as timer 15 which produces a pulse at a rate which may be equivalent to the expected heartbeat of patient 10. The output of either timer 15 or electrocardiac monitor 14 can be selected by means of switch 17.

"Referring to FIG. 2, the human heart, illustrated in section, comprises a left atrium LA feeding a left ventricle LV which ultimately supplies blood to aorta AO. Upon electrical stimulation, the myocardium associated with left ventricle LV contracts causing an ejection of blood from left ventricle LV into aorta AO to supply blood to vital organs and muscles of the body. In particular, the leg muscles are supplied by femoral artery FA. The elastic recoil of the aortic arch forces some of the arterial blood back into the opening of the right and left coronary arteries at their origin in the cusps of the aortic valves. It is primarily after the closing of this valve, an interval referred to as diastole, that blood is supplied to the myocardium through the associated coronary arteries.

"The onset of systole can be electrically detected by the QRS complex, as shown in FIG. 3a as the R pulse. This R pulse signifies the electrical stimulation causing contraction of the left ventricle at the onset of systole. Systole is indicated in FIG. 3a as interval SS. The end of systole is indicated by the T wave signifying ventricular repolarization. The following contraction of the left atrium is indicated by the P wave also illustrated in FIG. 3a.

"Referring again to FIG. 1, a stimulating means is shown herein as tetanizing trigger and control system 16. The timing for system 16 is provided from electrocardiac monitor 14 or timer 15 depending on the position of switch 17. In response to the periodic signals from switch 17, system 16 provides a tetanizing current on line 18 and 20. In this embodiment, the tetanizing current is applied from band 22 to bands 24 and 26. It is known to apply a tetanizing current across skeletal muscles of a patient who may be suffering from ailments such as tendonitis, neuritis, bursitis, or other muscle ailments. This therapy involves applying an alternating current across the muscle to contract it involuntarily for a predetermined interval, for example, five (5) minutes. However, this type of instrument has not been used nor proposed as a device for treating coronary disease." (col. 4, lines 9-53, underlining added)

The above makes clear that the timer 15 of Krikorian is not a signal processor, but merely a static counter which can be switched on and off using switch 17. This is reinforced by the following disclosure in Krikorian:

"The augmenter comprises timing means for repetitively producing a trigger signal. The augmenter also includes a stimulating means for repetitively applying to the patient a stimulating current. This current is sized to involuntarily contract and relax at least one muscle of the patient in response to the trigger signal." (col. 2, lines 46-52)

This clearly demonstrates that there is no signal processor present which is capable of varying the stimulation signals delivered to a patient on a pulse-by-pulse basis as required by independent claim 18.

The fact that there is no signal processor present in Krikorian is further emphasized by the fact that to calibrate the various signals applied to the patient, the operator can interrupt the treatment cycle by switching a switch associated with the calibrator 70 and change the output signals of the static components by varying the gain of the respective amplifiers and passive delay units so that the pulses applied to the patient from the analog passive circuitry 136 of Krikorian can be calibrated according to the patient's EKG signals (see col. 8, line 47 to col. 9, line 49).

Thus, Krikorian does not teach or in any manner suggest:

- a signal processor capable of deriving a time delay corresponding to the end of the T-wave required by independent claim 18;
- use of a signal processor to trigger the circuit applying electrical stimulation to one or more active electrodes at said derived time delay, also as required by claim 18; and
- the limitation of claim 18 that the processor must be capable of determining for successive pairs of signal peaks a value corresponding to the time between successive pairs of signal peaks.

It should further be noted that the timer 15 - erroneously referred to in the Office Action as being a processor - is not part of the tetanizing trigger and control circuitry 16 of Krikorian. It is this passive circuitry 16, shown in detail in Figs. 4, 5 and 6, which is responsible for delivering impulses to a patient. Thus, the timer 15 of Krikorian is an integral part of the

circuitry 16, but merely provides a reference signal to activate the circuitry 16. Therefore, the timer 15 only influences the generation of the signals produced in the circuitry 16. It cannot influence a change in signal parameters, let alone vary the signals delivered to the patient on a pulse-by-pulse basis. In particular, it cannot carry out any of steps a) to n) of the <u>signal processor</u> recited in independent claim 18.

Turning now to "Chou", and assuming that Chou refers to the same Chou reference (WO 98/05379) over which all claims were rejected in the Office Action of October 1, 2009, and which rejection has since been retracted, and which was discussed in depth on pages 9-14 of the Amendment filed February 17, 2010, Chou does not disclose a <u>signal processor</u> and, more importantly, Chou does not use the counterpulsation mode. For the reasons discussed at the beginning of these Remarks, applicants do not understand how Krikorian was combined with Chou in support of the holding that all pending claims are obvious. In the following, applicants therefore repeat their statements and arguments as presented on pages 9-14 of the Amendment filed February 17, 2010:

Chou, over which all claims, including independent claim 18, were previously rejected in the Office Action of October 1, 2009, teaches to stimulate a human body with reoccurring bursts of energy. The stimulating mechanism includes a sensing mechanism for synchronizing the stimulation with the heart beat of the human body by causing energy bursts to occur at the same rate as the heart beat of the human body. As disclosed on page 1, lines 23-25 of Chou, Chou is particularly useful in reducing the pain and discomfort caused by various human ailments such as headaches, arthritis, rheumatism, back pain and drug and alcohol withdrawal symptoms and is not intended, as is true for the present invention defined by claim 18, to help in the treatment of heart load problems.

Fig. 4 of Chou discloses a portion of an electrocardiogram showing various phases of a heart beat cycle; in particular it shows a QRSTP diagram of the human heart and indicates the systole and diastole phases of the human heart. The only reference in Chou to the T-wave of the human heart is the indication of its position in Fig. 4.

As persons of ordinary skill in the art know, many treatments have been proposed and used in the prior art which affect the cardiovascular system of human beings. Well known among such systems are cardiosynchronized electrophysiological methods and apparatus, which comprise methods by which the heart pulse rate is predetermined by means of a sensor and stimulation is delivered in a rhythm at any time within the heart cycle and is synchronized in some way with the heart cycle. Such cardiosynchronized methods and apparatus can be subdivided into two classes, namely the simpulsation mode and the counterpulsation mode. Chou is concerned exclusively with the simpulsation mode, whereas the present invention is concerned exclusively with the counterpulsation mode.

In the simpulsation mode of a cardiosynchronized electrostimulation of muscles disclosed by Chou, the electric impulses are synchronized with the heart pulse rate so that the heart and the stimulated muscle are contracting at the same time; i.e. in the systole phase the heart is contracting and the stimulated muscle is contracting, in the diastole phase the heart is relaxing and the muscle is relaxing.

In the counterpulsation mode of a cardiosynchronized electrostimulation of muscles of the present invention defined by claim 18, the electric impulses are timed in such a way, relative to the heart pulse rate, that the heart and the stimulated muscle are contracting in opposition to each other; i.e. in the systole phase the heart is contracting and the stimulated muscle is relaxing, in the diastole phase the heart is relaxing and the stimulated muscle is contracting.

The cardiosynchronized electrophysiological methods using the simpulsation mode do not result in a significant change of the heart load when compared to the heart load of the same person without that person being subjected to stimulation. A person of ordinary skill in the art will recognize from Fig. 4 of Chou that Chou stimulates the patient using the simpulsation mode and not, as is the case in the present invention, the counterpulsation mode.

This is clear because Chou does not provide electrical stimulation to the human heart in a region around the end of the T-wave. Thus, Chou essentially discloses a prior art

device as is discussed on pages 4-8 of WO 01/13990 A1. Chou does not teach or in any manner suggest to a person of ordinary skill in the art that counterpulsation is possible, nor does Chou teach or suggest that one can use the Bazett relationship to calculate the position of the T-wave relative to the R-peak in a patient's heart rate spectrum.

Moreover, considering the synchronizing mechanism of Chou which is adapted to produce energy bursts using a stimulating mechanism that stimulates at the same rate or frequency as the human heart beat, the heart beat being detected by the sensing mechanism, Chou teaches in relevant parts that:

"This apparatus includes a stimulating mechanism for stimulating a living human body 10 with reoccurring bursts of energy" (page 4, lines 14-15 of Chou).

"The apparatus of the present invention further includes a sensing mechanism for sensing the heartbeat of the human body 10. In the embodiment of FIG. 1, this sensing mechanism includes a heart activity sensor 18 adapted to detect the cyclic activity of the human heart and detector circuitry 20 coupled to the heart activity sensor 18 for detecting the occurrence of unique points in the heartbeat cycles. The heart activity sensor 18 may include electrocardiogram (ECG) electrodes adapted to be attached to the human body 10 for sensing the electrical currents produced by the activity of the heart" (page 6, lines 20-26).

"When the sensing mechanism uses electrocardiogram electrodes, detector circuitry 20 detects the occurrence of the R wave peaks of the ECG signal" (page 7, lines 9-10).

"The embodiment of FIG. 1 further includes a synchronizing mechanism coupled to the stimulating mechanism and to the sensing mechanism for synchronizing the body stimulation with the heartbeat by causing the energy bursts produced by the stimulating mechanism to occur at the same rate or frequency as the human heartbeat detected by the sensing mechanism. This synchronizing mechanism includes circuitry for producing reoccurring control signal bursts for controlling the activation of the stimulating mechanism, time delay circuitry 27 for determining the position of the control signal bursts relative to the detector

output pulses and time duration circuitry 28 for determining the time duration of the control signal bursts" (page 7, lines 14-22).

Thus Chou detects the heart rate of a patient; i.e. Chou performs step a) of claim 18 of the present application. However, Chou does not compare the detected heart rate to either maximum or minimum technical or predetermined limits as is the case in steps b) and c) of claim 18 and, importantly, Chou does not perform step a) using a processor. Consequently, steps d) to g) of claim 18 are also not carried out by Chou. Moreover, there is no motivation or teaching in Chou which would lead a person of ordinary skill in the art to modify the apparatus in Chou in such a manner that he would be able to include comparisons like those recited in steps a) to n) of claim 18.

Chou further teaches:

"The time delay circuitry of FIG. 2 is responsive to the detector output pulses from detector 20 for producing delayed pulses each having a selected time delay relative to its detector pulse. Thus, the reoccurring bursts of energy supplied to the human body 10 for stimulating the body need not occur at precisely the same moment as the peak value in the heartbeat signal" (page 10, lines 4-8 of Chou).

This seems to suggest that the operator of the electrotherapy apparatus of Chou can vary the delay of the burst of energy to stimulate a patient. However, as will become clear in the following, this delay is not readjusted for each heart beat, but it is fixed by the operator for the duration of the treatment once he has adapted the variable resistor on the electrotherapy apparatus of Chou. In contrast thereto, the processor recited in claim 18 of the present application readjusts the delay of the stimulation pulse for every heart beat, to ensure that the stimulation pulse is administered to the patient during every heart beat cycle at the same point relative to the T-wave, irrespective of the changes of the heart rate. The position of the T-wave however changes as is best described by the Bazett relationship.

Further, Chou discloses:

"The selected coarse delay pulse appearing at the output of OR gate 44 triggers the multivibrator 45 and the resulting fine delay pulse produced by multivibrator 45 appears on the multivibrator output line 48" (page10, lines 24-26).

This confirms that the synchronization means of Chou does not include a processor, let alone that this processor is capable of calculating, determining and comparing the parameters of the heart rate detected using the ECG of the present application. Instead Chou uses static components such as the multivibrators mentioned above.

Chou additionally states:

"As shown in FIG. 3, the delayed pulses on line 48 are supplied to a trigger input of a further monostable multivibrator 50. Each delayed pulse on line 48 triggers the multivibrator 50 to produce on the multivibrator output line 51 a pulse having the desired stimulation time duration. This time duration is determined by the resistance value of adjustable resistor 52 and the capacitance value of the capacitor 53 which are connected to the time constant inputs of the multivibrator 50. By adjustment of the resistor 52, this time duration can be varied over a range of 1 to 10 milliseconds or longer. Multivibrator 50 is triggered by the trailing edge of each delayed pulse appearing on the input line 48" (page 11, lines 12-19).

The foregoing passage from Chou clearly demonstrates that the duration of stimulation of the apparatus of Chou is fixed for a treatment cycle and can only be adapted externally by an operator by varying the adjustable resistor 52, but there is again no automated process for carrying out an adjustment of the stimulation length, let alone that such an adjustment could be carried out using a processor. Moreover, the step above is not equivalent to step i) of claim 18, and since the delay is fixed and the duration of stimulation is fixed for each treatment cycle by the operator of the apparatus of Chou, steps j) to n) of claim 18 are also not performed by the apparatus of Chou. Since there is no teaching or suggestion in Chou to automate the readjustment of the stimulation length or the delay time, there is no motivation for a person of ordinary skill in the art to consider Chou, far less would Chou suggest or in any way motivate a

person skilled in the art to use a processor in the manner recited in claim 18 to realize a much more sophisticated stimulation method.

Lastly, Chou teaches:

"The time of occurrence of the trailing edges of the time duration control pulses of waveform 70 is determined by the RC time constant for the multivibrator 50 and, more particularly, by the setting of the resistance value of the adjustable resistor 52. As indicated in FIG. 5, the time of occurrence of this trailing edge is adjustable to provide the desired duration for the energy burst which is supplied to the stimulating mechanism" (page14, lines 21-25).

This too demonstrates that no processor is used in Chou. Instead, static components are used which are set up at the beginning of a treatment cycle of a patient and do not vary during the treatment of that patient.

In conclusion, Chou does not disclose or suggest to one of ordinary skill in the art the use of a processor. Moreover, Chou does not disclose to carry out steps b) to n) of claim 18. As demonstrated above, Chou is only concerned with stimulating the patient rhythmically, but not in any defined manner.

Thus, Chou has not recognized and does not disclose or suggest to one of ordinary skill in the art that a reduction in heart load problems can be achieved by stimulating the heart in the counterpulsation mode, i.e. relative to the end of T-wave, as is evident from the fact that the synchronization mechanism of Chou does not include a processor which performs steps a) to n) of claim 18 and, separately therefrom, as further evidenced by the fact that Chou does not carry out steps b) to n) of claim 18.

As demonstrated in great detail above, neither Chou nor Krikorian discloses or in any manner suggests a signal processor. The arbitrary combination of Krikorian and Chou does not result in an electrotherapy apparatus having a signal processor, let alone a signal processor which is adapted to carry out steps a) to n) of independent claim 18. A person of ordinary skill in the art would have no reason to contemplate this combination of the two references based on both what the references do and do not teach and his/her knowledge, experience and background

as a person of ordinary skill in the art. Even if the person of ordinary skill in the art were to include, for no apparent reason, a signal processor in the combined teachings of Chou and Krikorian, the combined references, as well as the knowledge, experience and professional background, still provide no basis for carrying out steps a) to n) of claim 18.

Independent claim 18 is therefore not obvious over Krikorian and "Chou".

A contrary conclusion can only be arrived at with hindsight based on what is disclosed in the present application, which is impermissible.

Claims 19-24 and 38, which depend from claim 18, are directed to detailed features of the present invention which are independently patentable. These claims are further allowable because they depend from allowable parent claim 18.

CONCLUSION

In view of the foregoing, applicants submit that this application is in condition for allowance, and a formal notification to that effect at an early date is requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at (415) 273-4730 (direct dial).

Respectfully submitted,

J. Georg Seka
Reg. No. 24,491

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, 8th Floor
San Francisco, California 94111-3834
Tel: (415) 576-0200
Fax: (415) 576-0300
JGS:jhw
62765713 v1